Topic:

Random Walk, Brownian Motion, Trading Risk, Arcsine Distribution

Assumption:

1. Trader has i.i.d. daily P&L which follows normal distribution with zero expected value, i.e.

$$P\&L_n = \sum_{t=1}^{n} P\&L_t \quad , n \geq 1 \, , \; P\&L_0 = 0$$

$$where \; P\&L_t \sim N(0, \sigma^2) \; [i.e. Random \; Walk]$$

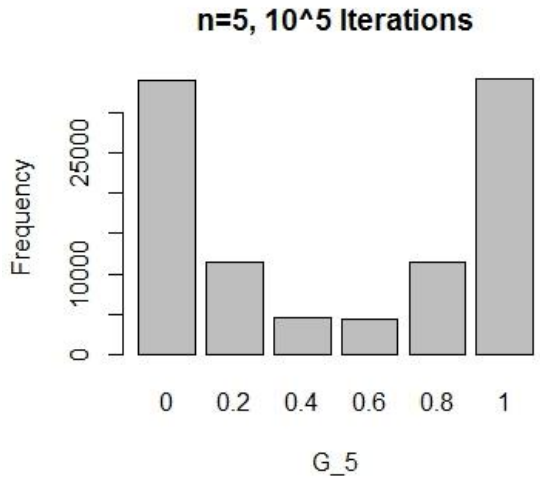
$$G_n = \frac{1}{n} \sum_{t=1}^{n} 1_{\{ P\&L_t > 0 \}}$$

$$[proportion \; of \; time \; when \; trader \; makes \; profit \; over \; the \; first \; n \; periods]$$

Simulation:

Simulation has been done based on the above distributions and assumption over 5, 20 and 500 periods respectively. By doing so, the proportion of time when trader is making profits has found to follow an arcsine distribution, that is, a trader would either make profits most of the time or make losses most of the time over a given period according to the assumption above.

Case 1: n= 5



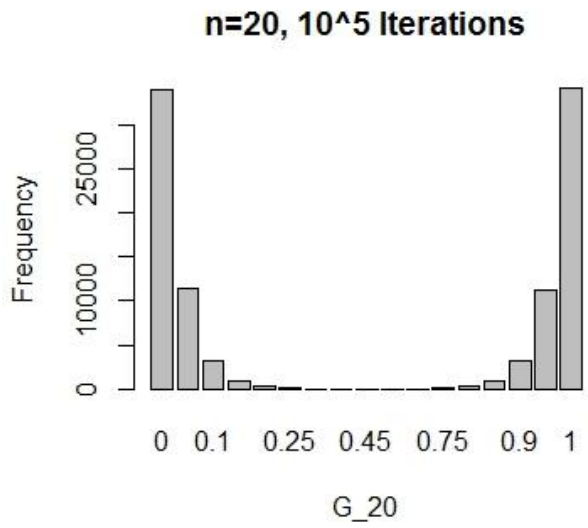
Execution time:

User	System	Elapsed
5.53 seconds	0.19 second	5.96 seconds

Probability mass function:

G_5	PMF
0.0	0.33933
0.2	0.11455
0.4	0.04498
0.6	0.04429
0.8	0.11513
1.0	0.34172

Case 2: n= 20



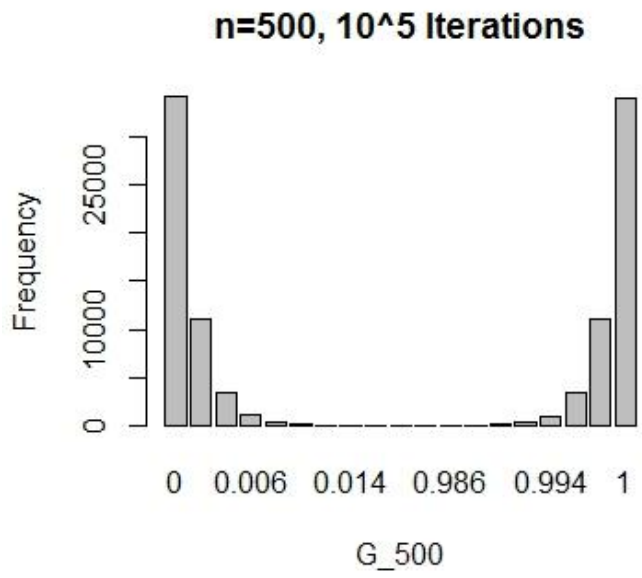
Execution time:

User	System	Elapsed
19.04 seconds	0.45 second	20.75 seconds

Probability mass function:

G_20	PMF
0.00	0.34003
0.05	0.11365
0.10	0.03296
0.15	0.00968
0.20	0.00313
0.25	0.00078
0.30	0.00021
0.35	0.00005
0.45	0.00001
0.65	0.00008
0.70	0.00028
0.75	0.00074
0.80	0.00278
0.85	0.00975
0.90	0.03304
0.95	0.11154
1.00	0.34129

Case 3: n= 500



Execution time:

User	System	Elapsed
643.25 seconds	183.50 second	899.53 seconds

Probability mass function:

G_500	PMF
0.000	0.34182
0.002	0.11148
0.004	0.03352
0.006	0.01041
0.008	0.00297
0.010	0.00083
0.012	0.00022
0.014	0.00007
0.016	0.00002
0.018	0.00001
0.984	0.00001
0.986	0.00008
0.988	0.00028
0.990	0.00091
0.992	0.00307
0.994	0.0094
0.996	0.03356
0.998	0.11062
1.000	0.34072